Letters

Steel Overkill?

Much of the structural work described in the article "Expanding a Kitchen" (8/11) appears to be excessive or not effective. (It is also of interest that while plans by an "engineer" are noted, the name of the engineer is not reported.) First, the flitch beam does not appear to be necessary. Scaling from your floor plan (using a stair width of 7.5 feet), the beam span appears to be 14 feet 4 inches. For a "suburban Maryland" location, ground snow load is very likely either 20 or 25 psf, meaning roof snow load is then less than 20 psf — perhaps much less. So for design purposes, 20 psf is reasonable and conservative. The only other loads are from the attic space and short wall. My basic calculations show that, even for conservative deflection limits (L/480 live load and L/300 total) and long spans (total gable roof span of 30 feet and attic joist span of 15 feet), an 11⅞-inch-by-3½-inch LVL beam is more than adequate. The section drawing shows that a taller LVL beam would fit in the attic.

Second, the columns supporting each end of the beam are shown to bear on the end of a floor joist, directly over a steel girder. Reinforcing the entire length of one floor joist with a 7-inch steel plate is not necessary; solid wood blocking under the column is more than adequate.

Finally, the need for steel channels to reinforce the other floor joists is doubtful. Also, bolting steel channels to the floor joists with one row of bolts does not reinforce the joists. To be effective, such reinforcement must either be connected to the joist with two rows of closely spaced connectors, near the top and bottom of the joist, or have full support at each end (essentially a separate beam). Without support at the ends, two rows of connectors are necessary to transfer the bending moment from the joist to the channel. With only one row of bolts, there is no way for the bending moment to be resisted by the channel.

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Author Rob Zschoche responds: Your letter seems to suggest that I did the engineering myself on this project; I can assure you that's not the case. (The article also doesn't state the names of the plumber, electrician, hvac contractor, and building inspector — all of whom are quite real!) Whether the flitch beam was overkill or just good conservative design, I can't say. But I do know that when the plan reviewer at the code enforcement office first analyzed the loading on that beam (including the heavy hanging cabinet below and an attic heat pump and planned attic storage, which the article didn't mention), he overlooked the steel plate and didn't like the answer he got. I pointed out the steel (which was quite clear on the drawings), he ran the numbers again, and I got the permit. While a taller LVL beam might have fit, working space was limited on every part of this job, so shallower members were helpful from an installation standpoint.

This was particularly true for the existing floor system, which was full of hvac ducts, gas pipes, plumbing, and wiring. The joists were in bad shape, having been excessively notched and bored, especially along their bottom edges. (The article incorrectly identifies the joists as 2x10s; they were in fact 2x8s.) The need for reinforcement was obvious; the existing tile was cracked, as the article points out, and there was no way I was going to install a new tile floor on such a weak substrate. The new kitchen would also have heavier appliances and a large peninsula. On some projects, we might have sistered in new full-length 2x8s or LVLs, but in this case, given the mechanicals and tight working conditions, that approach wouldn't work. The ends of some of the joists were inaccessible, so it would have been nearly impossible to maneuver full-length joists into the space and get bearing at both ends everywhere. The engineer's plan — bolting on structural C-channel with a single row of bolts [see editor's note below] — worked great. The full-length steel plate to which you object was specified because there was no room to get a channel into that particular joist bay; it was no heavier than the C-channel, and it was just a coincidence that it was on the joist beneath the post. Overall, using steel seemed like a good solution. That's why I hired an engineer — to provide a strong, economical design that would work in the tight space.

[Editor's note: Mr. Mann raises an important point regarding the bolting patterns used to attach structural steel members to lumber. If the C-channel were light-gauge steel, it's conceivable that it could buckle or warp under load if it were attached with only a single row of bolts. The much heavier structural steel channel is unlikely to warp because it is stiffened by its thick flanges. By contrast, the plate steel mentioned in the article, because it has no flanges, is fastened to the joist with a double row of bolts, along the top and bottom, to ensure that it stays flat. The last point Mr. Mann raises, that the C-channel must bear at the end, does not apply. That's because in a typical

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uniformly loaded floor, the bending moment is greatest in the center of the span and approaches zero at the ends. The steel carries the load midspan and the joists provide bearing at the ends. For this configuration to work, the bolt holes must be accurately sized so there is no slippage between the wood and the steel, and the bolts must be spaced far enough apart so as not to introduce a split along the grain of the joist.]

Economics of Attic Insulation

I was very disappointed in the answer to the question about attic insulation (*Q&A*, 9/11). The question was honest: If more attic insulation helps in a heating climate, does this approach work in a cooling climate? The answer is there — yes — but the response continues with a lot of feel-good anecdotes, extraneous facts, and side issues, with no real explanation. Denigrating the idea of diminishing returns is misguided and, in this case, misguiding. Cost-effectiveness is a well-established concept. It is easy to spend $100 to save $1, but it doesn't make much sense. To say that because it's cheap to add a little more insulation, we therefore should is a logical fallacy. Analyzing situations where the "time value" of money is involved — such as comparing first costs with annual savings — is daunting to many individuals, but there are standard, well-accepted, and straightforward ways to do this.

The cost of the installed insulation and the value of energy saved can be calculated with good accuracy given the climate parameters. Both the insulation cost and its returned savings will vary with insulation thickness. Further, there is an optimum thickness that can be found based on the dollar costs and the dollar savings. In most cases, the optimum insulation level is very broad. If 12 inches is the optimum, 10 or 14 inches of insulation can have returns similar to those of 12 inches. The effects of inflation, expected costs of fuel, and other factors can be included in a rational, quantitative analysis.

True, adding insulation can return value in other areas such as sound absorption or reduced air infiltration. But the values of these can be found not only in term of one's perception, but also in terms of what it would cost to achieve the same result in other ways. There are circumstances — such as existing flanking paths — that even an unlimited amount of insulation would do little to address.

Other factors, such as "how green" the insulation is or the customer's perception of quality and coziness, can enter into a decision about insulation thickness. But unless there is an unlimited amount of money available, those factors will rarely be primary.

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Author Mike Rogers responds: While it's true that quantitative analysis can be used to determine optimal insulation levels, you have to recognize that many assumptions are built into the analysis. A formula that takes into account such factors as the NPV (net present value) of money, projected fuel costs, and projected weather patterns may be very precise, but it isn't necessarily accurate. In fact, it's generally agreed that energy-savings projections performed by skilled practitioners using the best available models are notoriously hit-or-miss, even when adjusted with hourly weather data. The more powerful modeling tools make assumptions not only about temperature differences between the attic and the living space, but also about the impact of factors like insolation and evaporative cooling, which can vary significantly. To be absolutely accurate, a model also has to account for the impact of temperature on insulation R-value, since it varies with both temperature and insulation material. The analysis gets complicated quickly, and there are pretty big error bars around that "optimal" value based on savings alone. I would go so far as to say that the calculated optimal value is unlikely to be correct!

But perhaps the biggest mistake of most of the ivory-tower analyses is the assumption that installed insulation cost varies linearly per inch. It doesn't. By far the most expensive part of adding extra insulation to a project is all of the prep — especially air-sealing but also travel time, setup and cleanup, and the associated overhead costs of permits, inspections, marketing, sales, and administration. When you look at the actual incremental costs — not linearly extrapolated incremental costs — adding insulation well beyond currently recommended levels often makes good economic sense. The math works.

Amory Lovins (cofounder of the Rocky Mountain Institute) talks about "tunneling through the cost barrier," meaning we are sometimes too shortsighted with our cost/savings analysis. By pushing further and incurring some "additional" costs, we can actually avoid other bigger costs. For example, superinsulating may cost more and may seem to push us too far down the cost-effectiveness curve. Until, that is, we're able to do things like virtually eliminate space heating and distribution systems and their associated costs.

In fact, the above holds even if we limit the benefit side of the analysis to the energy savings alone. But that's a mistake, because the savings is not why our customers perform upgrades. Comfort is the biggest reason — "coziness" is in fact primary!

KEEP 'EM COMING!

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